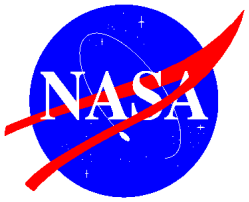

George C. Marshall Space Flight Center

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REVISION A
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STANDARD OPERATING PROCEDURE

MTS AERO-90
LOAD CONTROL SYSTEM
GENERAL OPERATING PROCEDURES

APPROVING AUTHORITY

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APPENDIX

ACRONYMS & NOMENCLATURE

ALCS	AUTOMATIC LOAD CONTROL SYSTEM
ASCII	AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE
CE	CONTROL ENGINEER
D I/O	DIGITAL INPUT/OUTPUT
DDC	DIRECT DIGITAL CONTROL
DSSC	DIGITAL STRUCTURAL SERVO-CONTROLLER
HDIS	HYDRAULIC DUMP INTERFACE SYSTEM
LCS	LOAD CONTROL SYSTEM
LP	LINE PRINTER
LTC	LABORATORY TEST CONTROLLER
LVDT	LINEAR VARIABLE DISPLACEMENT TRANSDUCER
MIOP	MULTI-FUNCTION INPUT/OUTPUT PROCESSOR
MTS	MEASUREMENT TEST SYSTEMS
SST	STATIC STATION TEST
UPS	UNINTERRUPTIBLE POWER SUPPLY

OVERVIEW
LOAD CONTROL SYSTEM
MTS AERO-90

The following discussion describes the current status and capabilities of the MTS Aero-90 Load Control system.

System Configuration

Current capabilities for Aero-90 load application control consist of a 144 channel, two station digital control system and two 32 channel, single station digital control system that are structured into four major subsystems as indicated below:

- Operator Workstation
- Laboratory Test Controller (LTC)
- Digital Structural Servo-Controller (DSSC)
- Uninterruptible Power Supply (UPS)

These subsystems are networked through a combination of the following.

- Serial communications links for high-speed data transfer
- Digital Input/Output (D I/O) for controlling event critical actions
- System synchronization connections for test synchronization
- Error detection interlocks

Summary of Attributes and Capabilities

The following is a summary of attributes and capabilities of the four (4) subsystems. An Equipment Capabilities Reference is also delineated in Appendix C.

Operator Workstation

The Operator Workstations provide test control applications and are comprised of the following.

- Alpha Workstations
- PC Workstation

From the operator workstations the Control Engineer (CE) can perform the following operations.

- Develop test spectrums (profiles)
- Initialize test parameters
- Tune servo-controllers
- Operate individual tests
- Display activity status during test conduct
- Modify load profiles under test conditions

- Laser Printer

  HP Laser Printers are utilized for high resolution bit mapped graphics printing.

- Static Station Test Control Panel

  The CE precisely controls load application during test conduct via the Static Station Test (SST) Control Panel, which provides the load application control functions depicted in Figure 2.

  Test conduct operations provided by the Test Control Panel are monitored and complemented by the workstation.

The Laboratory Test Controller (LTC)

The Laboratory Test Controller facilitates the communication between the operator workstation and the servo-controller. The functions performed by the LTC are delineated below.

- Controls Host and LTC Communications
- Transmits Load Profile Segments for the Test Setup to the Servo-controller
- Manages the Test Station Control Module. The Test Station Control Module includes 16 Digital Input/Output (D I/O) lines and it manages the following.
  - Test Control
  - Synchronization
  - Safety Interlocks and Error Conditions
  - Test Control Panel
  - Events and Action
  - Station Communications
  - Hydraulic Interface
- Controls Disk and Tape Operations

Note: The LTC Configured to Support Test Control

The LTC is based on a VME bus with multiple processors and special purpose circuit board modules. A Motorola 68030 based processor module provides system

supervision, network communications, and disk and tape control. An additional Motorola 68030 based processor supervises the test control network and servo-controllers. The system is synchronized by the "MTS-AIM" module which also incorporates the multi-station interlock logic.

The "Test Control D I/O Interface" module is included to provide independent control for the test station control panel, digital input and output lines, and hydraulic service manifold and pump control. The D I/O interface module communicates through a "D I/O bus" to the test station control module. (Refer to Figure 3)

The Digital Structural Servo Controller (DSSC)

The DSSC subsystem provides multiple channels of synchronized servo-control at test frequencies ranging from 0.01 to 50 Hz. The DSSC console contains MIOP II circuit board modules and each module controls up to four channels. The DSSC console contains three separate hardware chassis that provide the hardware and firmware to facilitate control algorithms, transducer conditioning, and servo-valve drive for multiple control channels. (Refer to Figure 4)

Note: The MTS load application system software can function with up to 512 channels of servo-control by adding servo-controllers, conditioners, and valve driver modules.

The functions performed by the DSSC are delineated below.

- Manages the test station, command generation, 50 end-level circular buffers, and test shutdown recorder.

- Monitors system interlocks and error conditioning.

- Communicates with LTC.

- Provides multiple control channels with Direct Digital Control (DDC) which performs the following functions.

  - Error Limit Detection
  - Proportional Gain
  - Integral Gain
  - Derivative Gain
  - Feed Forward Gain
  - Integrator Limit
  - Piston Area Ratio

  Also, servo controller channels include Low Signal Level Input for feedback with:

  - Linearization
  - Polarity switching

- Limits-Warning and Shutdown with selectable persistence

- Function Generation - Ramp, Haversine, or Triangular
- Null Pacing - Static and Dynamic
- Error Interlock Lockout
- Analog Test Point - Command, Feedback, Error, or Output

Uninterruptible Power Supply (UPS)

The UPS provides adequate battery backup power, exceeding 15 minutes for the entire control system, exclusive of the hydraulic supply. It also provides lightning and surge protection.

1.0 PURPOSE

This document establishes the methodology required to power-up, setup, operate, and power-down the MTS AERO-90 Load Control System (LCS) to support structural loads test programs.

2.0 SCOPE

The general steps to activate, operate, and secure the LCS are specified and described herein. The procedures in this document can be adapted to a specific test operating procedure.

3.0 REFERENCE DOCUMENT

- All MTS AERO-90 Load Control System OEM supplied manuals.

4.0 SAFETY

4.1 EMERGENCY TELEPHONE NUMBERS

General Emergency	911
Security	4-4357
Ambulance	911
Utilities	4-3919
Fire	911
Safety	4-0046

NOTE

THE TEST AND CONTROL ENGINEERS IN CHARGE OF THE LOAD CONTROL SYSTEM ARE RESPONSIBLE FOR ENSURING ADHERENCE TO THE APPROPRIATE PROCEDURES AND POLICIES FOR TEST SETUP AND TEST CONDUCT.

ANY ACTIVITY INVOLVING THE LOAD APPLICATION SYSTEM DURING TEST CONDUCT MUST BE COORDINATED WITH THE TEST ENGINEER.

4.2 EMERGENCY PROCEDURE

In the event an emergency arises during activation and operation of the LCS, the test engineer must be informed of the emergency conditions. The test engineer shall be prepared to respond to any contingency that may occur and coordinate the contingency action with other test personnel.

5.0 TEST CONTROL ENVIRONMENT READINESS

5.1 SERVO-CONTROLLER INSTALLATION AND CALIBRATION

The operator must perform several tasks prior to operating the servo-controller to conduct a test. These tasks include:

- Completing the connections from the servo-controller back plane connectors to the hydraulic servo valve and to the feedback device (e.g., load cell or LVDT).
- Determine the calibration values, so the system can correctly set its gain to accurately apply the desired loads or strokes.
- Verify the correct polarity of the signals to the hydraulic servo valve and from the load cell or LVDT to assure correct operation of the closed control loop. Standardized wiring of cables makes this process necessary only one time.

Note. Refer to Appendix C for a detailed description of these tasks.

5.2 HYDRAULIC LOAD LINES ACTIVATION

THE SEQUENCE OUTLINED IN **SOP-GENLCS002-JDO-072999** (REFER TO APPENDIX D) MUST BE FOLLOWED TO ACTIVATE THE HYDRAULIC LOAD-LINES PRIOR TO TEST CONDUCT. PRIOR TO ACTIVATION OF THE HYDRAULIC LOAD-LINES, THE LOAD CONTROL SYSTEM MUST BE READY TO SUPPLY APPROPRIATE COMMAND SIGNALS AND THE SERVO-CONTROLLERS MUST HAVE BEEN CALIBRATED TO APPLY THE REQUIRED 100% TEST LOADS IN RESPONSE TO THE APPROPRIATE COMMAND SIGNALS.

6.0 POWERING UP THE SYSTEM

6.1 START SYSTEM WORKSTATION COMPUTERS (ALPHA STATION):

With electrical power applied, the workstations will take approximately 5 minutes to boot-up and run diagnostics. At the **Digital username/password** window, type **AERO** for both username and password, which will start the Aero-90 test control application software.

6.2 APPLY ELECTRICAL POWER TO THE DSSC CONSOLE THEN THE LTC:

Note: There will be an improper boot-up if the LTC is powered up before the DSSC. The consoles will take approximately 15 minutes to boot-up and run diagnostics. After boot-up is completed, all interlock lights on the consoles should be extinguished, indicating a DSSC/LTC console ready status.

6.3 APPLY ELECTRICAL POWER TO THE HDIS AND VERIFY THAT IT IS ACTIVE:

On the HDIS, verify the Dump Armed/Disarmed switch is in the Disarmed position. On the Switch and Indictor Panel, verify all switches are in the up(cut) position and all lamps on active test channels, plus supply, are illuminated.

6.4 VERIFY UPS OPERATIONAL STATUS:

AC Line and Ready lamps should be illuminated.

NOTE

The flow of instructions that follow is structured to illustrate system operation for a typical test preparation and operation scenario. There is no attempt to describe all possible branches and options available; that knowledge will evolve with usage and experience.

7.0 TEST PREPARATION

The following sequence of activities are typical for preparation of test conduct using the Aero-90 ALCS. An Aero-90 Calibration Worksheet and Hydraulic Worksheet will be used in concert with execution of the tasks described herein. These procedures assume the operator to be fully cognizant of the Aero-90 Test Control Software Reference Manual, including its instructional contents and terminology.

NOTE

After receipt of hydraulic load control test requirements for a particular test, the following four items should be completed in preparation for the setup of the Aero-90 LCS.

- Complete Aero-90 Calibration Worksheet
- Complete Hydraulic Worksheet
- Connect load cell feedback cables and servo-valve cables
- Connect HDIS to both Aero-90 ALCS and Hydraulic System

7.1 AERO-90 LCS INITIALIZATION

Follow the procedure as stated in the Section 6.0, *POWERING UP THE SYSTEM*, and continue.

7.2 CHANNEL CALIBRATION

7.2.1 Select (**Calibration**) module from the **Control Master Menu**.

7.2.2 From the window appearing as a result of the previous step, select (**Calibration File**), then (**OK**). This will allow the operator to modify the system calibration file.

7.2.3 DC Conditioner full-scale-range calibration:

7.2.3.1 From the **Calibration** window, select a physical channel to calibrate under **Channel Selection**, then select (**Assign Calibration Channel)** to enable calibration functions for the selected channel number.

7.2.3.2 Assign Polarity (**Inverted** for load cell feedback, **Normal** for LVDT feedback).

7.2.3.3 From the **Calibration** window **Options** menu, select (**Transducer Table**).

7.2.3.4 From the window appearing as a result of the previous step, enter a **Full Scale** value (FSR from the calibration worksheet) and select appropriate units under **Units List** for selected assigned channel, then (**Dismiss**).

7.2.3.5 From the **Calibration** window **Options** menu, select (**Conditioner Outputs**) and (**Sensitivity Calibration**).

7.2.3.6 From the **Conditioner Outputs** window appearing as a result of the previous step, select Delta K Factor (**Disable**), and Display Units (**EGU**).

7.2.3.7 Under the **Sensitivity Calibration** window, select (**Slope Calibration**), enter the **mV/V/EGU** value from the calibration worksheet for the selected channel, and select (**Calculate**), then (**Dismiss**). **Note:** Disregard the sign (±) on the **mV/V/EGU** value when entering into the computer.

7.2.3.8 Select (**Auto Zero**) on the **Calibration** window. This automatically resets the Output Zero (V) slide bar for the value required to zero the conditioner output voltage. The Conditioner Output Display should read approximately zero.

7.2.3.9 From the **Calibration** window **Option** menu, select (**Shunt Calibration**).

7.2.3.10 From the window appearing as a result of the previous step, select Mode (**Manual**), Shunt Polarity (**Positive** or **Negative**), and Display Mode (**EGU**), then select (**Apply Shunt**). This connects an internal shunt resistor across the arm of the transducer or conditioner bridge circuit. **Note**: Use Positive shunt cal for compression and Negative shunt cal for tension.

7.2.3.11 Monitor the Conditioner Output Display on the **Conditioner Outputs** window.

7.2.3.12 From the **Calibration** window, adjust the **Gain** until the Conditioner Output Display matches the 49.9K-ohm value on the calibration worksheet for the assigned channel.

7.2.3.13 Record final **Gain** setting on calibration worksheet. **Note**: The calibration worksheet Calc Gain (approximated Gain) should be within ±5 counts of the final **Gain**. If not, investigate the problem before proceeding with setup.

7.2.3.14 On the **Shunt Calibration** window, select (**Release Shunt**), then (**Dismiss**).

7.2.3.15 From the **Calibration** window **Options** menu, select (**Shunt Verification Setup**).

7.2.3.16 From the window appearing as a result of the previous step, assign Entry Method (**Automatic**), Shunt Polarity (**Positive** or **Negative**), and Display Mode (**EGU**). Enter (**0.3**) for the Verify Limit (%), and Automatic Entry (**Perform**). Select Shunt Verify (**Verify**), then (**Dismiss**).

Note: This connects an internal shunt resistor across a positive or negative arm of the transducer bridge circuit and measures the resulting feedback signal. This measurement is displayed in the Read Value text box. The Automatic Entry and Verify Limit will be used during test conduct for servo check operations.

7.2.3.17 From the **Calibration** window **File** menu, select (**Save**). The **Save** function allows the operator to save the current file.

7.2.3.18 Return to *DC Conditioner full-scale-range calibration (7.2.3)* and repeat for each active channel. Continue to Sequence 7.2.4 after completing all active channels.

7.2.4 Prepare assigned channel for servo-loop tuning. Operator experience from previous tests may be utilized to set the servo tuning parameters, otherwise proceed as follows.

7.2.4.1 From the **Calibration** window, select a physical channel under **Channel Selection**, then select (**Assign Calibration Channel)** to enable servo-loop tuning functions for the selected channel.

7.2.4.2 From the **Calibration** window **Options** menu, select (**Limits**).

7.2.4.3 From the window appearing as a result of the previous step, enter a appropriate values for safe servo-loop tuning of the assigned channel for Conditioner Limits **Upper & Lower**, then (**Dismiss**). **Note:** Typically a value of 5% of maximum test load is sufficient for the Conditioner Limits when tuning the system.

7.2.4.4 From the **Calibration** window **Options** menu, select (**Valve Driver Parameters**).

7.2.4.5 From the window appearing as a result of the previous step, assign Valve Polarity (**Normal**).

7.2.4.6 From the **Calibration** window **Options** menu, select (**Control Parameters**).

7.2.4.7 From the window appearing as a result of the previous step, assign Proportional Gain (**0.1**), Integral Gain (**0.01**), and Feed Forward Gain (**0.0**), Outer Error Detector (**20.0**), Outer Error Persistence (**0.200**).

7.2.4.8 Connect an oscilloscope to the DSSC console, DC Conditioner feedback tip jack on the assigned channel. Monitor the DC Conditioner feedback signal on the oscilloscope.

7.2.4.9 From the **Calibration** window **Options** menu, select (**Function Generator**).

7.2.4.10 From the window appearing as a result of the previous step, select Wave Shape (**Square**) and enter appropriate values for the Amplitude and Offset.

7.2.5 Initialize hydraulics for servo-loop tuning:

7.2.5.1 Connect hydraulic hoses to the hydraulic system on the assigned channel.

Note: Verify that only the hydraulic hoses for the assigned channel are connected to the hydraulic system.

7.2.5.2 From the **Calibration** window, select (**Reset Interlocks**).

7.2.5.3 On the 454.20S SST Station Control panel, extinguish (**Reset/Intlk)** lamp if necessary.

7.2.5.4 From the **Calibration** window, select Hydraulics (**Enable**).

7.2.5.5 On the 454.20S SST Station Control panel, push Station Pressure (**Low**), then (**High**), and then push (**F1/RTL)** to zero command.

7.2.5.6 Turn *ON* the Hydraulic Servicer (pump) and adjust pressure to approximately 50psig.

CAUTION

Most of the parameters that can be controlled using the Calibration module can cause actuator movement when hydraulics are applied. Extreme caution should be used while performing the valve balance procedure. Depending on the size of a cylinder, a 50 psig hydraulic supply pressure can generate a significant amount of loading force. Unexpected actuator movement can result in personal injury or equipment damage.

7.2.6 Perform valve balance:

7.2.6.1 On the HDIS, place the (**Supply**) switch to the *ON* (down, lamp not illuminated) position. Place the assigned channel switch to the *ON* (down, lamp not illuminated) position.

7.2.6.2 While monitoring Conditioner Output Display on the **Conditioner Outputs** window, adjust the Valve Balance from the **Valve Amplifier** window until the Conditioner Output Display reads approximately zero load. Then, (**Dismiss**) the **Valve Amplifier** window.

7.2.7 Arm system automatic dump:

7.2.7.1 On the HDIS, toggle the (**RST**) switch to extinguish Dump indicator. Place the **Dump Armed/Disarmed** switch to the (**Armed)** position.

7.2.7.2 Place assigned channel, plus (**Supply)** switch, to the up (cut, lamp not illuminated) position on the HDIS.

7.2.7.3 From the **Calibration** window, (**Enable**) all Limits and Interlocks.

7.2.8 From the **Control Parameters** window, select Integrator (**On**).

7.2.8.1 Set Hydraulic System to approximately 200 psig.

7.2.8.2 Using the pressure values on the Hydraulic Worksheet, determine the operating pressure. Slowly increase Hydraulic Servicer pressure during the tuning process to the level required to perform test conduct for the assigned channel.

7.2.9 Tune the assigned channel:

NOTE

If, during the tuning process, an error limit detect causes a hydraulic dump, on the HDIS place the Dump Armed/Disarmed switch immediately to the Disarmed position, then lower Hydraulic Servicer (pump) pressure to approximately 50psig. From the calibration window disable all Limits and Interlocks. Investigate and resolve the problem, then return to Sequence 7.2.5, *Initialize hydraulics for servo tuning*, and continue.

7.2.9.1 On the 454.20S SST Station Control panel, push (**Backward)** once to initialize the Function Generator, then (**Backward)** again to begin servo command offset and cycling at the wave shape, amplitude, and frequency entered at the **Function Generator** window. **Note**: To stop the servo command cycling, push (**Stop/RTZ)**. To ramp servo command back to zero, push (**F1)**.

7.2.9.2 From the **Control Parameters** window, slowly increase Proportional Gain until the servo loop for the assigned channel has a good response verified by a sharp rising edge as seen from the assigned channel's DC Conditioner output on the oscilloscope.

7.2.9.3 Enter on the **Control Parameters** window a value for Integral Gain that is 10% of the final Proportional Gain.

7.2.9.4 On the 454.20S SST Station Control panel, push (**F1)** to zero servo command signal. Lower Hydraulic Servicer pressure to approximately 50 psig, then push (**Station Shutdown).**

7.2.9.5 On the HDIS, place the **Dump Armed/Disarmed** switch immediately to the (**Disarmed)** position.

7.2.9.6 From the **Calibration** window, (**Disable**) all Limits and Interlocks.

7.2.9.7 Enter the final Proportional (P) and Integral (I) Gain settings on the Aero-90 hydraulic worksheet.

7.2.9.8 From the **Calibration** window **Options** menu, select (**Limits**).

7.2.9.9 From the window appearing as a result of the previous step, enter Conditioner Limits (**Upper & Lower)**, **Outer Error Detector Limit,** and **Persistence** that are appropriate for test conduct, then (**Dismiss**).

7.2.9.10 From the **Calibration** window **File** menu, select (**Save**). This completes the tuning process for the assigned channel.

7.2.9.11 Return to Sequence 7.2.4, *Prepared assigned channel for servo tuning* and continue tuning for each assigned channel.

7.2.9.12 When all assigned channels have been tuned, turn *OFF* Hydraulic Servicer.

7.2.9.13 From the **Calibration** window **File** menu, select (**Print**) for active test channels and retain Calibration printouts for test file documentation.

7.3 CONFIGURE A TEST

7.3.1 Select the (**Configure)** module from the **Control Master Menu.**

7.3.2 From the window appearing as a result of the previous step, select (**New**).

7.3.3 From the window appearing as a result of the previous step, enter a **Configuration Name**, **Configuration Description**, and the **Number of Test Channels** for the new test, and select (**OK**).

7.3.4 Configure test for active test channels:

7.3.4.1 From the **Test Configuration** window, select a **Test Channel Number** using **Next** and **Previous**. **Note:** Test Channel Numbers are automatically assigned as 1 through previously entered Number of Test Channels. For the selected **Test Channel Number**, enter a **Description**.

7.3.4.2 Assign a **Physical Channel Number** to the selected Test Channel Number. **Note:** The Physical Channel Number is the actual physical position of the DC Conditioner and the Servo-Valve Driver in the DSSC console. Select (**Control or Monitor**) for the selected Test Channel number.

7.3.5 Configure operator limits:

7.3.5.1 From the **Configuration** window **Options** menu, select (**Operator Limits**).

7.3.5.2 From the window appearing as a result of the previous step, enter the 100% **Design Load** (**EGU**) for the selected Test Channel and appropriate Operator Range for **Operator Max (EGU)** and **Operator Min (EGU)**, then select (**Dismiss**).

7.3.5.3. From the **Configuration** window **File** menu, select (**Save**) and (**Print**), then (**OK**).

7.3.5.4 Retain Test Configuration printouts for test file documentation.

7.4 GENERATE LOAD CONDITIONS

7.4.1 Select the (**Load Condition**) module from the **Control Master Menu**.

7.4.2 From the **Select a Test** window appearing as a result of the previous step, select (**New**).

7.4.3 From the **New Load Condition Table** window appearing as a result of the previous step, **Select a Test** and enter the **Number of Load Conditions** for the selected test, then (**Dismiss**).

7.4.4 From the **Load Conditions** window **Options** menu, select (**Configuration Parameters**).

7.4.5 The **Configuration Parameters** window will appear providing a quick reference to the selected test configuration. Load conditions can now be entered manually or with the auto build utility.

7.4.6 Manual load condition entry: **Note:** Load conditions can be entered in either engineering units or as a % of design load.

7.4.6.1 From the **Load Condition** window **Options** menu, **Display % of Design Load** or **Display Engineering Units**. Select desired load condition cell and enter load conditions in either % of design load or engineering units.

7.4.6.2 From the **Load condition** window **File** menu, select (**File**) and (**Print**). Retain Load Condition printout for test file documentation.

7.4.7 Auto Build load conditions:

7.4.7.1 From the **Load Condition** window **Options** menu, select (**Auto Build**).

7.4.7.2 From the window appearing as a result of the previous step, select an **Increment Size (%)** and the **Maximum Load (%)** to populate the load condition table, then select (**OK**). An auto build warning will appear. Enter (**OK**).

7.4.7.3 From the **Load Condition** window **File** menu, select (**Save**) and (**Print**). Retain Load Condition printouts for test file documentation.

7.5 INITIALIZE LOAD PROFILE

7.5.1 Select (**Profile**) module from the **Control Master Menu**.

7.5.2 From the **Select a Test** window appearing as a result of the previous step, select (**New**).

7.5.3 From the **New Profile** window appearing as a result of the previous step, **Select a Test** and enter a **Profile Name** and the **Number of Profile Rows** required to run the test, then select (**OK**).

7.5.4 Generate load profile. Using the Load Condition printout from above, build the load profile from the **Profile** window as follows.

7.5.4.1 Select a row **Mode** cell, then space bar for an (**Insp/Print(s)**) cell entry for all row **Mode** cells.

7.5.4.2 Select a row **LC1** cell then enter the desired load condition number from the Load Condition printout. **Note:** Generally, row 1-LC1 will be zero load and row 2-LC1 will be tare load, if required.

7.5.4.3 Select a row **Time/freq** cell and enter a row transition time. **Note:** Generally, row 1 for zero load will be 5.00 sec and all other row transition times will generally be 45.00 sec.

7.5.5 Enter load transition names. If a transition name is desired for each row, define and enter the row names as follows.

7.5.5.1 From the **Profile** window **Options** menu, select (**Phase Tables**).

7.5.5.2 From the **Flight Phase Table Setup** window appearing as a result of the previous step, select an entry number then enter the desired Flight Phase name. When all desired flight phase names are entered, select (**Dismiss**).

7.5.5.3 To assign a load transition name to a Phase of Flight cell, select a Phase of Flight row cell and then space bar. The pop-up selection window will appear. From this window, select a load transition **Name**, then (**OK**).

7.5.6 Check load profile:

7.5.6.1 From the **Profile** window **Options** menu, select (**Open Graph**).

7.5.6.2 From the **Graph Profile** window appearing as a result of the previous step, select (**Choose all channels**) under the Test Control Channels window. (**Update**) the graph to display and verify no random load fluctuations.

7.5.6.3 Select (**Print**) for test file documentation of load profile graphs, then (**Dismiss**). Retain Profile printout for test file documentation.

7.5.6.4 From the **Profile** window **File** menu, select (**Save**) and (**Print**). Retain Profile printout for test file documentation.

7.6 GENERATE EVENT/ACTION MATRIX

7.6.1 Select the (**Event/Action**) module from the **Control Master Menu**.

7.6.2 From the window appearing as a result of the previous step, select a test name and (**Open**) the test.

7.6.3 Define events for remote emergency dump:

7.6.3.1 The following event or action definition will pull the Interlock to dump hydraulics when the manual dump button is pushed. From Event Selection, select Digital Input Events 1 (**Low to High**). Select System Actions for this event as (**Pull Interlock**) and (**Log Message**). Type **REMOTE DUMP ACTIVATED** for the Message To Log.

7.6.4 Define events for UPS Alarm:

7.6.4.1 The following event or action definition will print a status log message when the UPS AC input is lost or restored. From Event Selection, select Digital Input Events 16 (**High to Low**). Select System Actions for this event as (**Log Message**). Type **UPS AC INPUT LOSS** for the Message to Log.

7.6.4.2 From Event Selection, select Digital Input Events 16 (**Low to High**). Select System Actions for this event as (**Log Message**). Type **UPS AC INPUT RESTORED** for the Message to Log.

7.6.5 From the **Event/Action** window **File** menu, select (**Save**) and (**Print**). Retain Event/Action printout for test file documentation.

8.0 DOWNLOADING AND RUNNING A TEST

The following sequence of procedures are typical and the minimum required to safely run a structural loads application test using the Aero-90 ALCS. These procedures assume the operator to be fully cognizant of the Aero-90 Test Control Software Reference Manual, including its instructional contents and terminology.

8.1 AERO-90 ALCS INITIALIZATION

Follow the sequence and complete the procedures as stated in Section 6.0, *POWERING UP THE SYSTEM*, and continue as follows.

8.2 SYSTEM WORKSTATION INITIALIZATION OPERATIONS

8.2.1 Select the (**Static Test**) module from the **Control Master Menu**.

8.2.2 From the window appearing as a result of the previous step, **Select a Test** for the **SST Static Test**, then select (**OK**). The Configuration for the selected test will be downloaded to the LTC and DSSC consoles.

8.2.3 From the **Static Test** window **Options** menu, select (**Download Test Files**).

8.2.4 From the **Download Test Files** window appearing as a result of the previous step, **Select a Profile** or **Sequence** and (**Download**). The Event Action, Load Conditions, Profile/Sequence, and Verify Profile/Sequence parameters will be downloaded to the LTC console.

8.2.5 From the **Static Test** window **Options** menu, select (**Special Function Keys**).

8.2.6 From the window appearing as a result of the previous step, select for the F1 Action (**Zero Command**) and for the F2 Action (**Immediate Branch**), then (**Dismiss**). This defines the functions of the F1 and F2 keys on the 454.20 SST Station Control Panel while in testing mode.

8.2.7 From the **Static Test** window **Options** menu, select (**SST Static Test**). This window should be left on the screen while running the test.

8.2.8 Perform Servo Check:

8.2.8.1 From the **Static Test** window **Options** menu, select (**Servo Check**).

8.2.8.2 From the window appearing as a result of the previous step, select which channels and servo-control parameters to check. Then, Select (**Print**) and (**Dismiss**). Retain the printouts for test file documentation.

8.2.9 Select the (**Run Time Display**) module from the **Control Master Menu**.

8.2.10 From the **Station Select** window appearing as a result of the previous step, select (**OK**).

8.2.11 From the **Data Display Manager** window, select (**Display Selection**) and (**Open Display**).

8.2.12 From the window appearing as a result of the previous step, select under Recent History (**Tabular**) and (**Summary**) displays. These displays should be left on the screen while running the test.

8.2.13 Ready the system for hydraulic pressure:

8.2.13.1 From the **Static Test** window, disable all Master MIOP Limit Settings and Master Interlock Settings.

8.2.13.2 Extinguish the (**Reset/Intlk**) lamp on the 454.20 SST Station Control Panel.

8.2.13.3 From the **Static Test** window, select mode (**Testing**) and Hydraulics (**Enable**).

8.2.13.4 Push Station Pressure (**Low**), then (**High**) on the 454.20 SST Station Control Panel; then the (**F1**) to zero servo command signals.

8.3 INITIALIZE THE HYDRAULICS

8.3.1 Turn *ON* Hydraulic Servicer (pump) and adjust pressure to approximately 50 psig. Monitor the Recent History Tabular display for any significant load increase while performing the following steps.

8.3.2 From the **Static Test** window, select Integrator (**ON**). On the HDIS, place the (**Supply**) switch to the *ON* (down, lamp not illuminated) position. Continue to place active channel switches to the *ON* (down, lamp not illuminated) position until all active channel switches are *ON*. **Note:** If a large load increase is seen occurring, return the channel switch to the *UP* (cut, lamp illuminated) position and investigate the problem.

8.3.3 Arm system automatic dump:

8.3.3.1 On the HDIS, toggle the (**RST**) switch to extinguish Dump indicator. Place the **Dump Armed/Disarmed** switch to the (**Armed**) position. Place all channels, plus supply switches to the *UP* (cut, lamp not illuminated) position.

8.3.3.2 From the **Static Test** window, select Master Interlock Settings (**Outer Error Detect**) and Conditioner Interlock (**ON**).

8.3.4 Set Hydraulic System test conduct pressure:

8.3.4.1 Using the pressure values from the Hydraulics Worksheet, slowly increase Hydraulic Servicer (pump) pressure to the level required (as determined from test setup load-line design) to perform test conduct.

8.4 TEST MANAGEMENT OPERATIONS

8.4.1 Run the test using the 454.20S SST Station Control panel at the execution direction of the Test Conductor. Push **Forward**, **Reverse**, or **Hold** on the SST Station Control panel to sequence through loads as defined by the load Profile table and Load Condition table developed previously.

8.4.2 To branch from one profile row to another, enter from the SST Static Test window a **Branch Row** and **Branch Time** and push the (**F2**) button on the SST Station Control panel to initiate the branch.

8.4.3 To modify the load Profile table or Load Condition table while running the test, select the **Profile** or **Load Control** modules from the **Control Master Menu**. Make the appropriate changes to the tables. And, from the **File** menu, select (**Save**), then (**Dismiss**) the module.

8.4.4 From the **Static Test** module **Options** menu, select (**Download Test Files**).

8.4.5 From the window appearing as a result of the previous test, select the (**Profile/Sequence**) and (**Load Condition**), then (**Download).**

8.4.6 From the SST Static Test window, select Profile name (**Update**) and load Condition Table (**Update**), then (**OK**).

8.4.7 Individual current loads may be modified from the SST Static Test window by selecting a channel from the Load Condition Table and entering the new load value, then select (**Update**) and (**OK**).

8.4.8 With Profile Printing (**ON**) in the **SST Static Test** window, a printout of load levels achieved during test conduct will be available. Print and Retain printouts for test file documentation.

9.0 POWERING-DOWN THE SYSTEM

9.1 HYDRAULIC SHUTDOWN

9.1.1 Emergency shutdown caused by structural failure or unknown cause:

9.1.1.1 On the HDIS, place the **Dump Armed/Disarmed** switch immediately to the (**Disarmed**) position.

9.1.1.2 Reduce Hydraulic Servicer pressure to 0 psig.

9.1.1.3 To save Recent History Recorder data, select from the **Static Test** window **Options** menu (**Retrieve Test Data**).

9.1.1.4 From the window appearing as a result of the previous step, **Enter a Name**, then select (**OK**). **Note:** The HS Shutdown Recorder Data must be reviewed at this time. If test conduct is reinitialized the HS Shutdown Recorder will be reset and all previous data will be lost.

9.1.1.5 Review data from the HS Shutdown Recorder using the Posttest Display, if required, to investigate the cause of shutdown.

9.1.1.6 To resume testing at the direction of the test conductor, select (**Reset Interlocks**) from the **Static Test** window. Return to Sequence 8.2.13, *Ready the system for hydraulic pressure*, and continue.

9.1.2 Posttest shutdown after completion of test conduct:

9.1.2.1 Verify applied loads indicate and are zero load. Reduce Hydraulic Servicer pressure to 0 psig.

9.1.2.2 On the HDIS, press the red (**Manual Dump**) button, or on the 454.20S SST Station Control panel the (**Station Shutdown**) button.

9.1.2.3 On the HDIS, place the **Dump Armed/Disarmed** switch immediately to the (**Disarmed**) position. To resume testing at the direction of the test conductor, return to Sequence 8.2.13, *Ready the system for hydraulic pressure*, and continue.

9.1.3 When no further testing is required, ready the total system for shutdown:

9.1.3.1 Turn *OFF* the Hydraulic Servicer (pump). From the **Data Display Manager** window **File** menu, select (**Quit**).

9.2 AERO-90 ALCS SHUTDOWN

9.2.1 Shutdown the LTC and DSSC consoles after test conduct:

9.2.1.1 From the **Static Test** window **File** menu, select **(Save)** and**(Quit)**, then **(OK)** to unload.

9.2.1.2 From the **Control Master Menu Options** menu, select **(LTC Manager**).

9.2.1.3 From the window appearing as a result of the previous step, select (**Shutdown LTC**) and (**Acknowledge**). After approximately 5 minutes, remove electrical power from the DSSC console then the LTC console.

9.2.2 Shutdown the System Workstation Computer.

9.3 TEST CONDUCT SHUTDOWN DUE TO LOSS OF SYSTEM POWER

9.3.1 AC power loss to UPS system:

9.3.1.1 An audible alarm will sound from the UPS and an "**AC INPUT LOSS**" message will appear on the **Static Test** window status log. Assuming there is still hydraulic pressure available from the Hydraulic Servicer (pump), test conduct can safely continue for up to 5 minutes. However, prior to elapse of the 5-minute period, return to Sequence 9.1.2, *Post test shutdown after completion of test conduct*, and terminate test conduct. The latter is necessary to effect an orderly and controlled total shutdown of all test conduct functions.

9.3.2 AC power loss to Hydraulic Servicer (pump):

9.3.2.1 Loss of hydraulic pressure will cause an almost immediate hydraulic shutdown. Return to Sequence 9.1.1, *Emergency shutdown caused by structural failure or unknown cause*, and continue.

9.3.3 AC power loss to workstations:

9.3.3.1 Assuming hydraulic pressure is available and the HDIS, LTC, and DSSC consoles still have power, the 454.20S SST Station Control panel can be used to safely unload the test article. Workstations can re-connect to test after AC Pwr is applied if desired.

9.3.4 AC power loss to LTC or DSSC consoles:

9.3.4.1 This scenario is catastrophic in that no controlled shutdown is available and the consequences will be an immediate hydraulic dump. **IMMEDIATELY** turn *OFF* the Hydraulic Servicer (pump).

10.0 LCS TEST DATA ARCHIVE

At the completion of a test condition, LCS test data shall be archived. LCS test data will be kept on a CD-R data disk. The disk will be annotated with a start and finish date. The finish date will be recorded once the disk is full. This disk shall be maintained at the LCS work station until full. The disk shall then be archived in the quality documentation area.

Each test shall be archived on the data disk in a folder using the test program name. Sub-folders shall contain all test conditions performed.

The following items shall be archived on the LCS data disk to the appropriate sub-folder;

10.1 Aero-90 Calibration and Hydraulic Worksheets

Add a copy of the Aero-90 Calibration and Hydraulic Worksheets (**.xls file**) created as part of section 7.0 Test Preparation.

10.2 Load Conditions

10.2.1 Select (**Load Condition**) from the (**Control Master Menu**).

10.2.2 From the window appearing as a result of the last step, select the test to be archived.

10.2.3 Select (**File**) (**Export**). Enter a filename. Enter (**OK**).

10.2.4 Copy (**.ALC file**) from C:\mtsdata\mts Aero-90\translate directory to the LCS archive disk.

10.3 Profile

10.3.1 Select (**Profile**) from the (**Control Master Menu**).

10.3.2 From the window appearing as a result of the last step, select the test to be archived.

10.3.3 Select (**File**) (**Export**). Enter a filename. Enter (**OK**).

10.3.4 Copy (**.APR file**) from C:\mtsdata\mts Aero-90\translate directory to the LCS archive disk.

10.4 Configuration

10.4.1 Select (**Configure**) from the (**Control Master Menu**).

10.4.2 From the window appearing as a result of the last step, select the test to be archived.

10.4.3 Select (**File**) (**Print Setup**). Select the print to file box. Enter (**OK**).

10.4.4 Copy (**.txt file**) from C:\mtsdata\mts Aero-90\print directory to the LCS archive disk.

10.5 Calibration Data

10.5.1 Select (**Static Test**) from the (**Control Master Menu**).

10.5.2 From the window appearing as a result of the last step, select the test to be archived.

10.5.3 From the **Static Test** window Options menu, select (**Tuning**).

10.5.4 Select (**File**) (**Export**). Select (**Test Information**) and enter (**OK**).

10.5.5 From the templates, Select ARCHIVE_TEMPLATE and enter a filename. Enter (**OK**).

10.5.6 Copy (**.LIF file**) from C:\mtsdata\mts Aero-90\import directory to the LCS archive disk.

Figure 1. VAX Station Model 3100

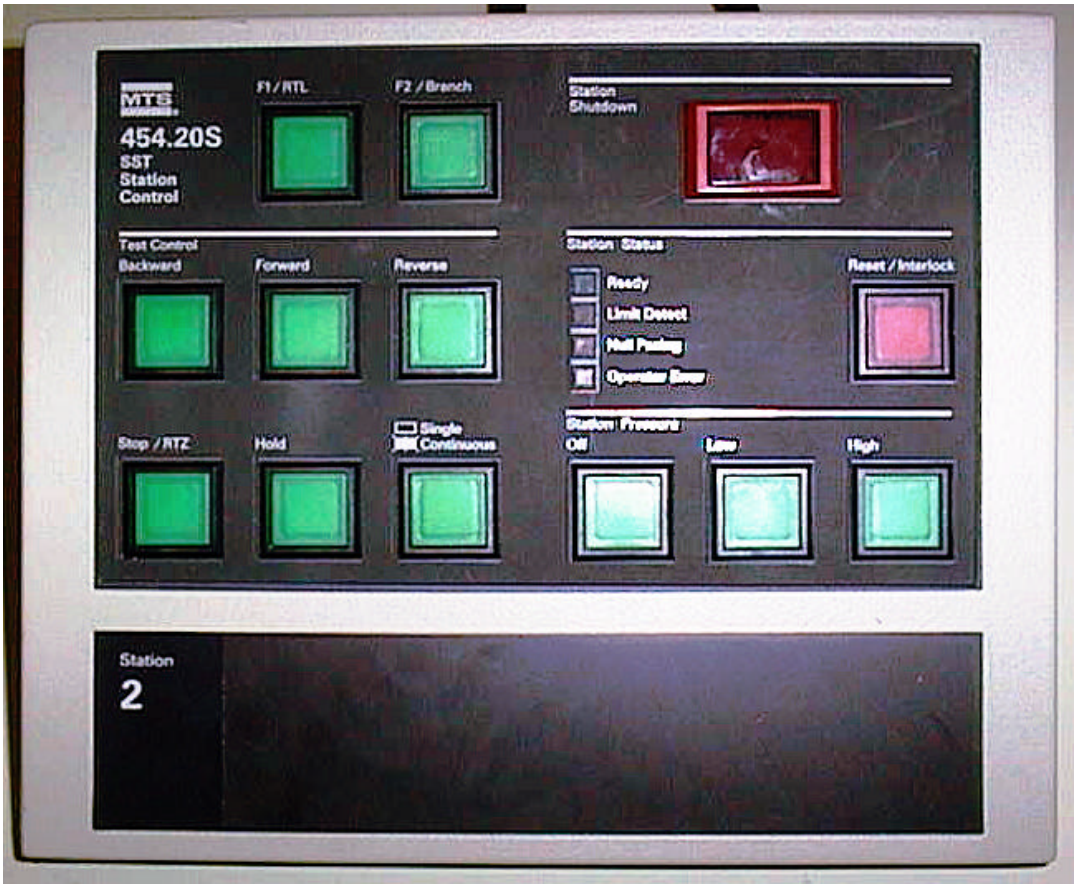

Figure 2. Static Station Test (SST) Control Panel Overlay

Figure 3. Laboratory Test Controller (LTC) Configured For Test Control

Figure 4. Digital Structural Servo-Controller (DSSC)

APPENDIX A

DEVELOPING THE AERO-90 CALIBRATION AND HYDRAULICS WORKSHEET

This procedure describes the steps required for generation of the Aero-90 Calibration Worksheet and the Hydraulic Worksheet that are used in concert with the setup and test conduct procedures employing the Aero-90 ALCS. Both worksheets are available as a template inside the ED27 Group Folder as LCSTemplate.xls.

NOTE

Load Cell electronic data files and Test Requirements documentation will be required to supply the data parameter inputs for the worksheets. The Microsoft Excel User's Guide should be referenced for supplemental instructions on entering data parameters into the worksheets.

Open the Excel Template, LCSTemplate.xls in the ED27 Group Folder. This file contains two sheets. Sheet 1 is the Aero-90 Calibration Worksheet. Sheet 2 is the Hydraulics Worksheet.

A.1 AERO-90 CALIBRATION WORKSHEET

A.1.1 Enter a (**Test Name**) and (**Test Date**). The Cell entry values for this worksheet will be taken from Load Cell electronic data files and the Test Requirements Document. Data are entered by selecting a cell and typing the appropriate information.

A.1.2 Make the following cell entries, if needed.

- **CH#** Auto entry. This cell indicates the physical channel number of the ALCS DSSC console.
- **TEST ID** Enter a name for the selected ALCS channel.
- **LCID/PG s/n** Enter the dash number of the load cell or pressure transducer serial number being used on the selected ALCS channel.
- **MAX LD/Press Model**

  For a load control channel, the full scale range and subsequent polarity of the calibration (tension or compression) is dictated by the magnitude of the load (the highest load the hydraulic load- line will be required to achieve during test conduct) and which direction (tension or compression) the highest load will be applied. For a pressure transducer, enter the pressure transducer Model #.
- **T,C or P** Enter T for tension calibration or C for compression calibration for a load control channel or P for pressure channel.

A.1.3 Manual entries into the Aero-90 Calibration Worksheet are completed. Print and Retain a copy of the worksheet for test file documentation. On the toolbar select **(Aero-Cal Setup)**. All other fields of the template will be automatically filled.

A.2 HYDRAULIC WORKSHEET

A.2.1 Enter a (**Test Name**) and (**Test Date**). The Cell entry values for this worksheet will be taken from the Test Requirements Document and hydraulic cylinder data sheets. Data are entered by selecting a cell in the worksheet and entering the appropriate data.

A.2.2 Make the following cell entries, if required.

- **BORE** Enter the cylinder bore size for the selected channel.
- **ROD** Enter the cylinder rod size for the selected channel.
- **COMPAREA** No entry is needed. The cylinder compression side area is calculated from the previous **BORE** entry.
- **TENSAREA** No entry is needed. The cylinder tension side area is calculated from the previous **BORE** and **ROD** entries.
- **SPCOM** No entry is needed. The hydraulic supply pressure required to achieve the **MAXLD** for the selected channel in compression is calculated using other entries.
- **SPTENS** No entry is needed. The hydraulic supply pressure required to achieve the **MAXLD** for the selected channel in tension is calculated using other entries.
- **P, I, & D** Entries are derived during the preparation for test conduct, which includes channel calibration and servo tuning operations.

A.2.3 All other values will be automatically filled. Generation of the Hydraulic Worksheet is completed. Print and Retain a copy of the worksheet for test file documentation.

APPENDIX B

SAFETY FEATURES, FUNCTIONS, AND SYSTEM INTERLOCKS

B.1 SAFETY MONITORING AND ERROR DETECTION

Upon detection of a defined test anomaly, the MTS Aero-90 system will automatically and immediately perform the actions outlined in the Event/Action Matrix. The actions include Stop, Hold, Ramp-to-Zero, Ramp-to-Load, and Shutdown (dump).

B.1.1 TRACKING (INNER) ERROR

The MTS Aero-90 system implements two types of tracking assurance.

B.1.1.1 The Static Null Pacing checks that all channels have reached the commanded end-point before the next set of end-points are issued.

B.1.1.2 The Dynamic Null Pacing assures the system synchronization by changing the loading rate of all channels such that the slowest channel tracks the command within a specified error window.

B.1.1.3 Time-out Periods, Persistence, and Null Pacing Tolerance Bands are operator specified in accordance with specific test conduct requirements.

B.1.2 ABSOLUTE ERROR AND SERVO ERROR

B.1.2.1 The MTS Aero-90 system separates the functions of feedback limits and servo-controller error detection as described in the following.

B.1.2.1.1 A Limit Detector resides in the transducer conditioner and functions as the absolute or final authority. This limit detector utilizes software selectable and hardware implemented upper and lower limit detection. When tripped, this detector activates the interlock chain directly.

B.1.2.1.2 Two (2) levels of software enabled feedback limit detection are provided in the control loop. The inner limit detector is typically set to provide warning when the feedback exceeds upper and lower levels. The outer limit detector is typically used as a backup limit detector, set to initiate a programmed response such as hold, ramp-to-zero, ramp-to-load, or shutdown. Both inner and outer limit detector responses are operator programmed.

B.1.2.2 Two (2) servo-control error detectors (command verses feedback) are available. These error detectors operate simultaneously, but independently from the transducer conditioner limit detector. The inner error detector is typically set to provide warning

when the servo-control error exceeds upper and lower levels. The outer error detector functions as the absolute or final servo-control error authority. When tripped, the outer error detector activates the interlock chain directly.

B.1.3 DISCRETE ERROR

The test station is equipped with sixteen (16) optically isolated digital input lines and sixteen (16) optically isolated digital output lines. These D I/O lines are used to sense and control external events. A programmable D I/O, Event/Action table is utilized to gain complete flexibility for the use of these digital lines.

B.1.4 SYSTEM ERROR

All integrity errors encountered during test operation are communicated to the CE. A system event log file is continuously maintained during test operation and is available for inspection at anytime.

B.1.5 DUMP CONTROL RELAY

The MTS Aero-90 system interfaces with the hydraulic control facilities through the control of a hydraulic service manifold. The system controls double-pole form-C hydraulic dump relay contacts rated at 120 Vac, 20 amperes, resistive.

B.2 SYSTEM INTERLOCKS

The MTS Aero-90 system utilizes a number of system interlocks that senses various system conditions. Upon occurrence of a monitored condition, the system will automatically activate a designated corresponding event. Figure B-1 outlines the various system interlocks, and the events that cause them to occur.

SYSTEM INTERLOCKS

- An Interlock Shuts *OFF* Station Hydraulics
- The Test Station Has It's Own Interlock Chain
- Station Interlock Conditions:
  - Broken, shortened, or disconnected transducer cable
    Upper and lower.
  - -- Servo Controller Interlock:

    Upper and Lower Conditioner Interlocks. Outer Error Detector

    Direct Digital Control (DDC) software failure
    Analog voltage failure
  - Sync Bus Failure Interlock:

    Loss of Sync clock
  - VME Bus Failure Interlock:

    Control processor failure
    Control software failure
  - Console Power Failure Interlock
    Loss of console power

Figure B-1. System Interlocks

Refer to figure B-2, System Interlock Table, that lists potential problems, detection procedure, the technique implementation procedure by CE, and the expected system response.

System Condition	Detection Technique	Selection	System Response

Broken or disconnected transducer	Transducer conditioner excitation current limits (upper-lower)	Always enabled	Hardware opens station and hydraulic interlocks and activates load abort hardware Software controlled test shutdown
Transducer input signal outside limits	Transducer conditioner input limits (upper-lower)	Upper and lower limit entered at workstation May be Enabled or Dismiss	
Servo-controller failure (hardware or software) Real-time processor hardware or software failure	Servo-controller watch-dog timer and analog as voltage monitor Monitor of back plane signal: SYSFAIL	Enabled at power-up initialization	
Console power loss	Console interlock relays		
Loss of master sync clock	Hardware interrupt to real-time processor		Software opens station and hydraulic interlocks and activates load abort hardware Software controlled test shutdown
Network failure	Message time-outs	Always enabled	Software opens station and hydraulic interlocks and activates load abort hardware
Controller inputs limits • Outer limit • Inner limit	Servo-controller software checks for limits at each sampling period	Upper and lower limit, and persistence entered at workstation May be enabled or disabled	Activates Event Action Sequence • Outer limit shuts down test • Inner limit issues warning messages
Servo error limit	Servo-controller software checks for limits at each sampling period	Upper and lower limit, and persistence entered at workstation May be enabled or disabled	Activates Event Action Sequence • Outer limit shuts down test • Inner limit issues warning messages
External digital inputs • Customer specified	Limit switches Other computers	Selected and enabled by Event action matrix	Activities Event Action Sequence
Unreasonable input parameter values	Workstation checks parameter input values	Always Enabled. Limits can be changed by "privileged operator"	Error message is displayed showing allowable range of parameter

Figure B-2. System Interlock Table

APPENDIX C

QUICK REFERENCE OF EQUIPMENT CAPABILITIES

C.1 VAX BASED OPERATOR WORKSTATION

C.1.2 Personal Computer (PC) (when applicable)

- 1 system processor (Pentium)
- 32 Mbytes internal memory
- 1.44 Mbytes internal floppy disk
- Integral thin-wire Ethernet
- CD ROM
- Color Monitor
  - 27-inch display
  - 256-color display

C.1.3 LN-05-A2 Laser Printer

- 8 pages per minute print speed
- High resolution bit mapped graphics printing

C.1.4 Static Test Control Panel

- Test station emergency stop button with indicating light and reset button
- Hydraulic Off/Low/High buttons with indicating light
- Test status lights, System Ready, Null Pacing, and Limit Detection
- Static Test operator buttons with indicating lights for Continuous or Single Step mode, Backward, Foreword, Hold, Stop

C.1.5 System Cabling

a. System workstation to Laboratory Test Controller, 6 meters (20 feet)

b. Control Panel to LTC, 6 meters (20 feet)

C.2 LABORATORY TEST CONTROLLER

C.2.1 MTS Model 894.10 Laboratory Test Controller

a. MTS Model 490.81 Single Bay Console

- Cooling fan with cleanable filter
- Power distribution outlet strips
- Casters and lifting rings
- Power entry panel with switch

b. MTS Model 498.22 LTC Chassis

- System resource processors with Ethernet connector
- 300 Mbytes hard disk
- 150 Mbytes cartridge tape drive
- Mounted in single bay console

c. Test Station Control Module

- 16 user defined digital inputs and outputs
- Opto-22 digital input and output modules 24 Vdc at 2 Amps, maximum
- Mounted in single bay console
- Hydraulic supply control

C.2.2 Aero-90 Application Software

a. System Management

- DEC-Windows environment
- Setup and edit displays for:
  - Test Station Configuration
  - Data Base Management
  - Networking

b. Servo-Control

- DEC-Windows environment
- Setup and control displays for:
  - Test station
  - Servo Control

- Digital input/output
- Graphical monitoring displays
- Load spectrum programming
- Multiple circular data buffers
- Test system archive and database functions

c. Standard Software Licenses

- VAXstation Application Software
- VMS Operation System
- Dec-Windows
- Networking (TCP/IP, FTP, and DECNet)
- Real-time operation system and software

C.3 MULTICHANNEL DIGITAL CONTROL SYSTEM

C.3.1 MTS Model 894.20 Digital Structural Servo Controller

a. MTS Model 490.81 Single Bay Console

- Cooling fan with cleanable filter
- Power distribution outlet strips
- Casters and lifting rings
- Power entry panel with switch

b. MTS Model 498.23 Digital Structural Servo Controller (DSSC) Chassis

- System resource processors with Ethernet connector
- Mounted in single bay console
- 16 slots available for DSSC modules

c. MTS Model 498.55 MIOP-II-4 channel DSSC modules

- Adjustable Proportional, Integral, and Derivative (PID) controller
- Occupies one slot in 498 DSSC Chassis
- Two 16-bit inputs/controller - operator selectable for feedback per control channel
- One 16-bit servo-valve command output/controller per control channel
- One 16-bit test point output/controller with operator selectable test point location in the controller per control channel

- Selectable valve clamp with adjustable ramp-to-zero
- Front panel mounted test point - one per each control channel

d. MTS Model 497.01 Transducer conditioning analog chassis

- Mounted in single bay console
- 16 slots available for conditioners

e. MTS Model 467.22 Dual channel DC conditioners

- Occupies one slot in 497.01
- Shunt or Voltage calibration verification
- Selectable gain range from 1-5000
- ±10 Vdc excitation
- 120Ω to 1000Ω bridges
- Accommodates from 4 to 8-wire bridges

f. MTS Model 497.01 Servo-valve driver analog chassis

- Mounted in single bay console
- 16 slots available for servo-valve drivers

g. MTS Model 497.26 Two channel servo-valve driver(s)

- Occupies one slot in 497.01
- Provides a maximum of 100 mA / servo-valve
- Adjustable valve dither

C.3.2 System Cabling

a. Structural Servo-Controller to Laboratory Test Controller, 10 meters (30 feet)

- Thin-wire Ethernet
- System synchronization
- System emergency stop

b. Analog System Cables Connectors:

- Servo-valve
- Load Cell

C.4 UNINTERRUPTIBLE POWER SUPPLY

C.4.1 Uninterruptible Power Supply

- Provides adequate power for the entire control system
- Batter backup exceeds 20 minutes
- Lightning and surge protection. Passes both Class A and Class B ANSI/IEEE C62.42-45 tests